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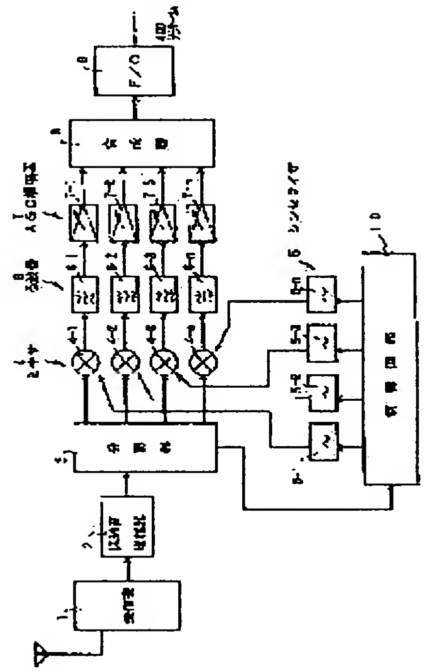
(54) MULTIFREQUENCY SIGNAL RECEPTION CIRCUIT

(57)Abstract:
PURPOSE: To improve distortion and an S/N at the time of optical modulation in a reception circuit for receiving multifrequency signals, converting them to optical signals and transmitting them.
CONSTITUTION: Received radio signals are separated into (n) channels in a separator 3 and respective separated reception signals are frequency converted to frequencies set in the respective channels in a mixer 4 by the output of a synthesizer 5, passed through a band-pass filter 6 and amplified to the same level in an AGC amplifier. By setting the frequencies of the respective channels to the frequencies for which the intermodulation distortion of the signals in the respective channels is not mutually influenced, the optical modulation for not receiving the influence of the intermodulation distortion even when the level difference of the reception signals is large and not causing the degradation of the S/N is realized.



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(54) [Title of the Invention] MULTI-FREQUENCY SIGNAL RECEIVING CIRCUIT

(57) [Abstract]

[Object] To introduce improvement with respect to distortion and S/N in optical modulation, in a receiving circuit which receives multi-frequency signals and converts them to an optical signal for transmission.

[Structure] Radio signals which have been received are separated by a separator 3 for n lines; each of the separated received signals is frequency-converted by a mixer 4 based on an output from a synthesizer 5 to have a frequency set for a corresponding one of the lines; and they are passed through a band pass filter 6 and are amplified by an AGC amplifier to have the same level. Frequencies for the respective lines are set to frequencies that would not allow intermodulation distortion of signals for the respective lines to influence each other, whereby optical modulation is achieved which does not allow suffering from influence of intermodulation distortion or deterioration of S/N even when difference in level between the received signals are large.

[Scope of Claim for Patent]

[Claim 1] A multi-frequency signal receiving circuit comprising a separator for separating received radio signals for n lines (where n is an integer equal to or greater than two), n line routes for frequency-converting and amplifying the separated received signals, respectively, a combiner for combining the signals from the respective lines, and a converter for converting the combined signals to an optical signal, wherein, the n line routes each include means for frequency-converting the separated signal so that a resulting signal will have a frequency previously set for the line, and an amplifier for amplifying the frequency-converted signal so that a resulting signal will have a predetermined level, and wherein frequencies set for the respective lines are set to frequencies which prevent intermodulation distortions of the signals for the respective lines from influencing one another.

[Claim 2] The multi-frequency signal receiving circuit according to claim 1, wherein the frequency-converting means in each line is composed of a synthesizer for generating a local signal and a mixer for mixing this local oscillator signal with the received signal, thereby frequency-converting the received signal, and wherein the oscillatory frequencies of the synthesizers are variably controlled by a control circuit which operates based on the frequencies of the received signals and the frequencies set for the respective lines.

[Claim 3] The multi-frequency signal receiving circuit

according to one of claims 1 and 2, further comprising a receiver for receiving radio signals and a low-noise amplifier for amplifying the received signals, wherein the amplified received signals are separated for n lines.

[Claim 4] The multi-frequency signal receiving circuit according to one of claims 1 to 3, wherein each line includes a band pass filter for limiting a bandwidth for one line in accordance with the frequency set for the line.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a multi-frequency signal receiving circuit, and more particularly to a multi-frequency signal receiving circuit which receives numerous radio signals and transmits them in the form of an optical signal.

[0002]

[Prior Art] In general, in an optical microcell communication system for mobile communication (the system configuration is illustrated in FIG. 3), a base station 200 receives multi-frequency signals transmitted from numerous mobile units 100; the base station 200 frequency-converts and amplifies these signals and converts them to an optical signal, and transmits it to a control station 300 via an optical cable 400; and the control station 300 performs demodulation processing. As illustrated in FIG. 4, the base station, which performs such reception processing, includes

a low-noise amplifier 12 for amplifying radio signals for n lines received by a receiver 11 (where n is an integer equal to or greater than one), a local oscillator 14 and a mixer 13 for frequency-converting the amplified signals, a band-pass filter 15 having a pass band corresponding to a reception band, an amplifier 16, and an electrical to optical converter 17.

[0003] In this receiving circuit, the multi-frequency signals from the numerous mobile units 100 are collectively frequency-converted by the mixer 13 to have a predetermined frequency band; a signal component outside the band is removed by the band-pass filter 15; and thereafter the signals are amplified, subjected to optical modulation, and transmitted through the optical cable 400. In the control station, this optical signal is frequency-separated into signals corresponding to the respective mobile units and demodulation is performed, which enables reception of the signals from the mobile units. A receiving circuit of this type is "Sabukyaria Denso wo Mochiita Maikuroseru Hoshiki ni okeru Dainamikku Renji Kaizenho" ["Method for Improving Dynamic Range Using Subcarrier Transmission in a Microcell System"], Institute of Electronics, Information and Communication Engineers (1992) Spring Conference SB-6-5.

[0004]

[Problems to be Solved by the Invention] A receiving circuit having such a structure has a drawback in that distortion of a signal occurs and S/N is deteriorated when optical modulation is performed

by an electrical to optical modulator, since multi-frequency signals are collectively frequency-converted and amplified. Specifically, if optical modulation is performed on signals obtained by collectively frequency-converting and amplifying the received multi-frequency signals, intermodulation distortion occurs because of difference in reception input level between the signals, and distortion and S/N are deteriorated. In particular, a signal having a high reception input level will cause modulation distortion components to extend in a wide range, and accordingly, in a conventional system in which numerous radio channels are arranged at equal intervals in terms of frequency, this intermodulation distortion will cause considerable distortion and deterioration of S/N in the optical signal. Thus, there is a problem in that an element which is excellent in quality is required to optimize the distortion and S/N, and that long-distance transmission of light using an optical fiber is made difficult.

[0005] Conventionally, as disclosed in Japanese Laid-Open Patent Publication No. Sho 56-166690, a system is proposed in which multi-frequency signals which have been received are detected on a frequency-by-frequency basis, and each signal is independently frequency-converted, bandwidth-limited, and processed. Although performing processing on a signal-by-signal basis in this manner makes this system effective in performing subsequent processing properly, in the arrangement as disclosed in this patent publication, each signal is frequency-converted to have the same

frequency; therefore, this system cannot be adopted for a system in which optical modulation as described above is performed to transmit signals in the form of an optical signal. Further, even in the case where an arrangement in with multi-frequency signals are thus frequency-converted on a signal-by-signal basis and amplified is adopted, some improvement must be made in frequency conversion and amplification in order to prevent the above-described problems of distortion and deterioration of S/N from arising when these signals are subjected to optical modulation to transmit an optical signal.

[0006]

[Object of the Invention] An object of the present invention is to provide a multi-frequency signal receiving circuit which introduces improvement with respect to distortion and S/N in optical modulation. Another object of the present invention is to provide a multi-frequency signal receiving circuit which is capable of automatically improving distortion and S/N in accordance with the frequency of a received signal.

[0007]

[Solution to the Problems] A multi-frequency signal receiving circuit of the present invention includes a separator for separating received radio signals for n lines (where n is an integer equal to or greater than two), n lines each for frequency-converting and amplifying the separated received signal, a combiner for combining the signals from the lines together, a converter for

converting the combined signals to an optical signal, in which the n lines each include means for frequency-converting the separated signal to have a frequency which has previously been set for the line, and an amplifier for amplifying the frequency-converted signal to have a predetermined level, and in which frequencies set for the respective lines are set so that intermodulation distortion of a signal for each line would not influence each other.

[0008] The frequency-converting means for each line is composed of a synthesizer for generating a local signal and a mixer for mixing this local oscillator signal with a received signal, thereby frequency-converting the received signal; and an oscillatory frequency of the synthesizer is variably controlled by a control circuit which operates based on the frequency of the received signal and the frequency set for the line.

[0009] It is preferable that a receiver for receiving a radio signal and a low-noise amplifier for amplifying the received signal be provided, and that the amplified received signal be separated for n lines. Further, it is preferable that each line have a band pass filter which limits a bandwidth of the line in accordance with the frequency set for the line.

[0010]

[Mode of Operation] Signals which have been received are separated for n lines, and in the respective lines the separated signals are frequency-converted, and further, after being made to have

the same level, are combined together and subjected to optical modulation to be sent in the form of an optical signal. Frequencies for the respective lines are set in advance so that the resulting frequency arrangement will not cause intermodulation distortion. As a result, optical modulation is achieved which does not cause suffering from influence of intermodulation distortion or deterioration of S/N even in the case where difference in level between the received signals is large.

[0011]

[Embodiment] Next, an embodiment of the present invention is described with reference to the drawings. FIG. 1 is a block diagram of an embodiment of the present invention, and herein illustrates an exemplary case where it is applied to the base station in the optical microcell communication system for mobile communication, which is illustrated in FIG. 3. A receiver 1 receives signals (multi-frequency signals) from numerous mobile units utilizing n channels of lines (where n is an integer equal to or greater than two), and a low-noise amplifier 2 amplifies these received signals. A separator 3 separates the multi-frequency signals into frequency signals for n lines. Line routes corresponding to the n lines are each provided with a mixer 4 (4-1, 4-2, 4-3,⋯, 4-n); each mixer 4 is connected to a synthesizer 5 (5-1, 5-2, 5-3, ⋯, 5-n) for generating a local signal; and each mixer 4 uses this local signal to independently frequency-convert the received signal.

[0012] In addition, each mixer 5 is connected to a band pass filter 6 (6-1, 6-2, 6-3,···, 6-n) which is set to a mutually different frequency band, and the band pass filter 6 performs bandwidth limitation on the frequency-converted signal. Further, each band pass filter 6 is connected to an automatic gain control amplifier (AGC amplifier) 7 (7-1, 7-2, 7-3,···, 7-n), and the AGC amplifier 7 amplifies it so that it will have a predetermined level. In addition, a combiner 8 combines outputs from the respective amplifiers together and outputs them to an electrical to optical converter 9. This electrical to optical converter 9 performs optical modulation on the combined signals, and sends a resulting optical signal to the control station via an optical cable 400.

[0013] To each one of the line routes corresponding to the n lines, which are branches caused by the above-described separator 3, a frequency arrangement has previously been assigned, and setting is made such that each band pass filter 6 allows only a signal having the assigned frequency band to pass therethrough. Each one of the above-described synthesizers 5 is controlled by a control circuit 10 so as to generate a local signal having a frequency necessary for performing frequency conversion on a received signal received at the line so that the received signal will be converted to a frequency signal having the frequency arrangement which has been assigned to the line. In this case, in this embodiment, information of the frequencies allocated by the above-described separator 3 to the respective lines is inputted to the control

circuit 10, and based on this information of the frequencies, oscillatory frequencies for the synthesizers 5 are controlled.

[0014] According to a receiving circuit having this structure, radio signals for at most n number of lines received by the receiver 1 are amplified by the low-noise amplifier 2, and separated by the separator 3 into signals for the respective lines. Then, the signal for each line is mixed by the mixer 4 with an output from the synthesizer 5 and frequency-converted as a signal having the frequency band assigned to the line. Thereafter, the band pass filter 6 blocks a signal outside the frequency band for the line. At this time, as illustrated in FIG. 2 which shows an exemplary case of four frequencies F1 to F4, the frequency arrangements for the respective lines are set so that the signals for the respective lines would not influence intermodulation distortion of each other.

[0015] In the example of FIG. 2, setting is made so that a frequency interval between F1 and F2 and between F3 and F4 will be ΔF, and a frequency interval between F2 and F3 will be Δ2F, whereby an arrangement is achieved which does not cause mutual influence between intermodulation distortions of the signals having F1-F4. Note that this frequency arrangement is set, in advance, using a computer or the like based on the number of signals, distribution of distortion components, and the like. The description of this setting is omitted here because the technique for the setting is already established.

[0016] In accordance with the frequency arrangement which has been

set in this manner, the control circuit 10 recognizes, based on the information from the separator 3, the frequencies of the received signals which have been distributed to the respective lines; controls the oscillatory frequencies of the synthesizers 5 based on this information; and supplies, to the mixers 4 of the respective lines, local signals that will allow the received signals to become frequency signals according to the frequency arrangements assigned to the respective lines. Thus, the mixer 4 in each line frequency-converts the received signal so that the resulting signal will have a frequency according to the frequency arrangement assigned to the line. Thereafter, the signals for the respective lines are amplified by the AGC amplifiers 7 so that the resulting signals for the respective lines will have the same level, and the amplified signals are combined together by the combiner 8, subjected to optical modulation by the electrical to optical converter 9, and transmitted via the optical cable 400 in the form of an optical signal.

[0017] Thus, the frequency signals for the respective lines are combined together by the combiner 8 so as to maintain a frequency relationship which will not cause mutual intermodulation distortion. At the time of this combining, the respective AGC amplifiers have made the levels of the received signals for the respective lines identical to one another. Accordingly, even in the case where difference in level between the received signals is large, neither influence of intermodulation distortion nor

deterioration of S/N occurs at the time of the combining, and long-distance transmission of an optical signal using an optical fiber is made possible. Further, no special component is required.

[0018]

[Effect of the Invention] As described above, in the present invention, signals which have been received are separated for n lines, frequency-converted at the respective line routes, and amplified so that the resulting signals will have the same level, and then the signals for the respective lines are combined together, and the resulting signal is subjected to optical modulation to obtain an optical signal, in which frequencies for the respective line routes have previously been set so that a frequency arrangement will be achieved which does not cause intermodulation distortion. Therefore, even in the case where difference in level between the received signals is large, optical modulation is achieved which does not allow suffering from intermodulation distortion or deterioration of S/N. Thus, no special component element is required, and long-distance transmission using an optical fiber is achieved.

[0019] Frequency-converting means in each line variably controls the oscillatory frequency of the synthesizer which generates a local signal based on the frequency of the received signal and the frequency set for the line. As a result, it is made possible to process the received signal in each line regardless of difference in frequency between the received signals.

[0020] Further, providing the low-noise amplifier which amplifies a received signal leads to a higher sensitivity of the receiving circuit. Still further, providing to each line the band pass filter which performs bandwidth limitation for one line in accordance with the frequency set for the line makes it possible to avoid occurrence of overlapping of frequencies when combining the signals for the respective lines together and to prevent occurrence of distortion and deterioration of S/N at the time.

[Brief Description of the Drawings]

[FIG. 1] A block diagram of a receiving circuit according to an embodiment of the present invention

[FIG. 2] A diagram of a frequency arrangement illustrating an exemplary frequency conversion for received signals, in accordance with the present invention

[FIG. 3] A block diagram of a part of an optical microcell communication system to which the present invention is applied

[FIG. 4] A block diagram illustrating an exemplary conventional receiving circuit

[Description of the Reference Characters]

1 receiver

2 low-noise amplifier

3 separator

4 mixer

5 synthesizer

6 band pass filter

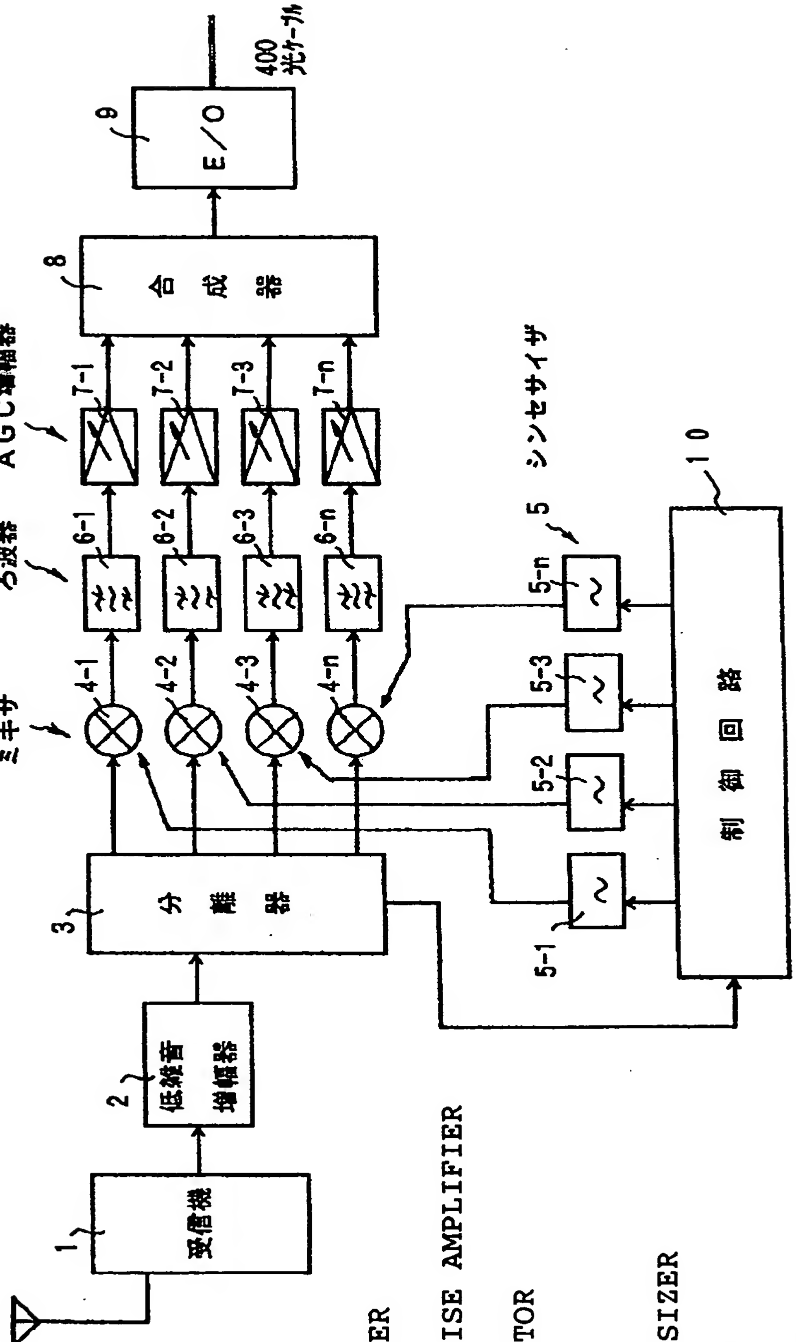
7 AGC amplifier

8 combiner

9 electrical to optical converter

10 control circuit

Fig. 1
【図1】



1 RECEIVER

2 LOW-NOISE AMPLIFIER

3 SEPARATOR

4 MIXER

5 SYNTHESIZER

6 FILTER

7 AGC AMPLIFIER

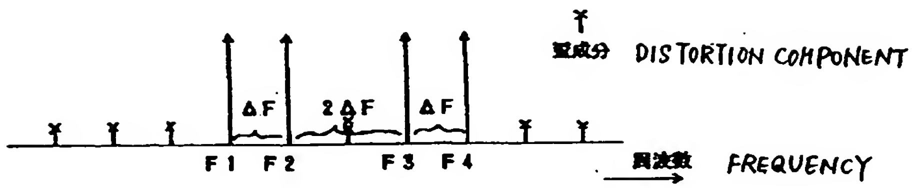
8 COMBINER

9 E/O

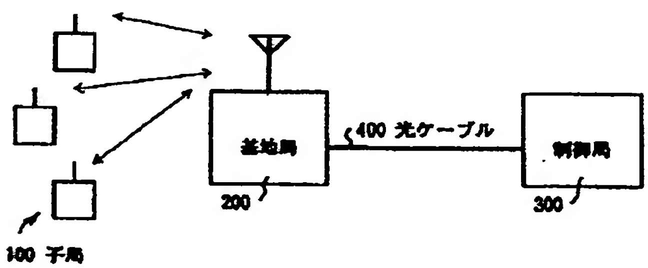
10 CONTROL CIRCUIT

400 OPTICAL CABLE

【図2】 Fig. 2



【図3】 Fig. 3



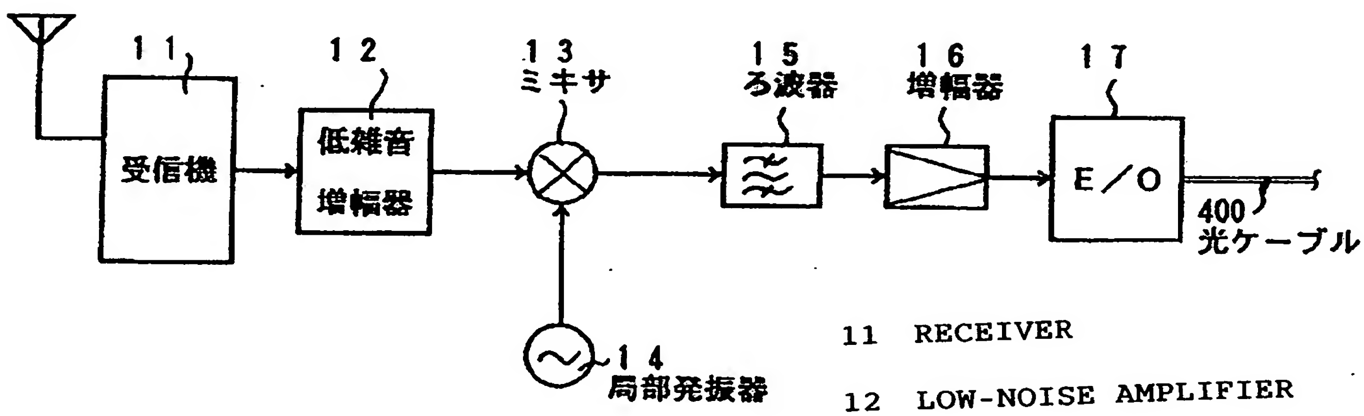
100 MOBILE UNIT

200 BASE STATION

300 CONTROL STATION

400 OPTICAL CABLE

【図4】 Fig. 4



11 RECEIVER

12 LOW-NOISE AMPLIFIER

13 MIXER

14 LOCAL OSCILLATOR

15 FILTER

16 AMPLIFIER

17 E/O

400 OPTICAL CABLE

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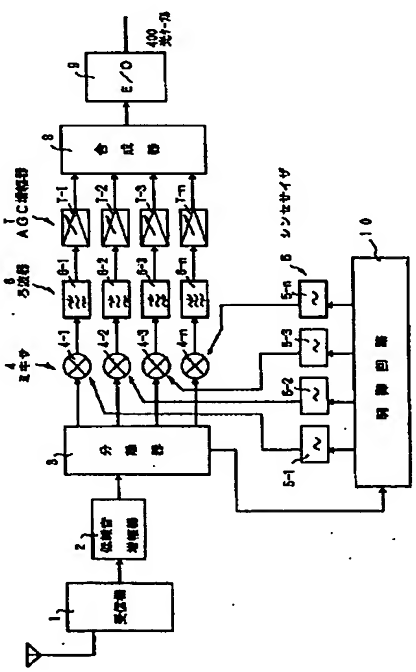
(54)【発明の名称】　多周波信号受信回路

(57)【要約】
【目的】　多周波数信号を受信し、これを光信号に変換して伝送する受信回路において、光変調に際しての歪やS／Nを改善する。
【構成】　受信した無線信号を分離器3においてn回線に分離し、各分離された受信信号をシンセサイザ5の出力により混合器4において各回線に設定されている周波数に周波数変換し、帯域通過ろ波器6を通過させ、AGC増幅器において同一レベルに増幅する。各回線の周波数を、各回線における信号の相互変調歪が互いに影響されない周波数に設定することで、受信信号のレベル差が大きい場合でも相互変調歪の影響を受けず、かつS／Nの劣化が生じない光変調が実現できる。



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【特許請求の範囲】

【請求項１】　受信した無線信号をｎ回線（ｎは２以上の整数）に分離する分離器と、分離された受信信号をそれぞれ周波数変換及び増幅するｎ回線路と、各回線からの信号を合成する合成器と、合成された信号を光信号に変換する変換器とを備え、前記ｎ回線路には、分離された信号をそれぞれの回線に予め設定された周波数に周波数変換する手段と、周波数変換された信号を所定のレベルに増幅する増幅器とを備え、かつ各回線に設定される周波数は、各回線における信号の相互変調歪が互いに影響されない周波数に設定されることを特徴とする多周波信号受信回路。

【請求項２】　各回線の周波数変換手段は、局部信号を発生するシンセサイザと、この局部発振信号を受信信号と混合して受信信号を周波数変換する混合器とで構成され、前記シンセサイザの発振周波数は、受信信号の周波数と、その回線に設定された周波数とに基づいて動作される制御回路により可変制御されるように構成してなる請求項１の多周波信号受信回路。

【請求項３】　無線信号を受信する受信機と、受信した信号を増幅する低雑音増幅器とを備え、この増幅された受信信号をｎ回線に分離してなる請求項１または２の多周波信号受信回路。

【請求項４】　各回線には、各回線に設定された周波数に対応して１回線の帯域を制限する帯域通過ろ波器を有する請求項１ないし３の多周波信号受信回路。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は多周波信号受信回路に関し、特に多数の無線信号を受信して光信号として伝送を行う多周波信号受信回路に関する。

【０００２】

【従来の技術】一般に、移動体通信の光マイクロセル通信方式では、図３にシステム構成を示すように、多数の子局１００から送信された多周波信号を基地局２００で受信し、基地局２００ではこの信号を周波数変換しかつ増幅した上で光信号に変換し、光ケーブル４００を通して制御局３００に伝送し、制御局３００において復調処理されるシステムがとられている。このような受信処理を行う基地局の構成は、図４に示すように、受信機１１において受信したｎ（ｎは１以上の整数）回線の無線信号を増幅する低雑音増幅器１２と、増幅された信号を周波数変換するための局部発振器１４及びミキサ１３と、受信帯域分の通過帯域をもつ帯域ろ波器１５と、増幅器１６と、電気光変換器１７とで構成されている。

【０００３】この受信回路では、多数の子局１００からの多周波信号はミキサ１３により一括して所定周波数帯域に周波数変換され、帯域ろ波器１５において帯域外の信号が除去された上で増幅され、かつ光変調されて光ケーブル４００を通して伝送が行われる。制御局では、この光信号を各子局に対応して周波数分離し、かつ復調することで、子局からの信号を受信することが可能となる。なお、この種の受信回路として、１９９２年電子情報通信学会春季大会、ＳＢ－６－５、サブキャリア伝送を用いたマイクロセル方式におけるダイナミックレンジ改善法、がある。

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【０００４】

【発明が解決しようとする課題】このような構成の受信回路では、多周波信号を一括して周波数変換し、かつ増幅を行っているため、電気光変調器における光変調に際し、信号の歪やＳ／Ｎが劣化されるという問題がある。即ち、受信した多周波信号を一括して周波数変換及び増幅した信号に対して光変調を行うと、各信号の受信入力レベルの差によって相互変調歪が影響し、歪やＳ／Ｎが劣化される。特に、受信入力レベルの大きい信号では、変調歪成分が広い範囲に生じるため、従来のように多数の無線チャネルが周波数上で等間隔に配置されるシステムでは、この相互変調歪により光信号において歪やＳ／Ｎの劣化が顕著なものとなる。このため、歪やＳ／Ｎが最善となるように特性の優れた素子が要求されたり、光ファイバでの長距離の光しごの伝送が困難になるという問題がある。

【０００５】なお、従来では特開昭５６－１６６６９０号公報に記載されているように、受信した多周波信号を各周波数毎に検出した上で、各信号を個々に周波数変換、帯域制限した上で、各信号を処理する方式のものが提案されており、このように各信号毎に処理を行うことで以降の処理を好適に行う上では有効であるが、この公報の構成では各信号をいずれも同一の周波数に周波数変換しているため、前記したような光変調を行って光信号として伝送する方式には採用することができない。また、仮に、このように多周波信号を各信号単位で周波数変換しかつ増幅する構成を採用した場合でも、その周波数変換及び増幅に際して何らの改善を行なわなければ、これらの信号を光変調して光信号を伝送する際には前記したような歪おやＳ／Ｎ劣化の問題が生じることになる。

【０００６】

【発明の目的】本発明の目的は、光変調に際しての歪やＳ／Ｎを改善した多周波信号受信回路を提供することにある。また、本発明の他の目的は、受信信号の周波数に応じて歪やＳ／Ｎを自動的に改善することが可能な多周波数信号受信回路を提供する。

【０００７】

【課題を解決するための手段】本発明の多周波信号受信回路は、受信した無線信号をｎ回線（ｎは２以上の整数）に分離する分離器と、分離された受信信号をそれぞれ周波数変換及び増幅するｎ回線路と、各回線からの信号を合成する合成器と、合成された信号を光信号に変換する変換器とを備えており、ｎ回線路には、分離された

信号をそれぞれの回線に予め設定された周波数に周波数変換する手段と、周波数変換された信号を所定のレベルに増幅する増幅器とを備え、かつ各回線に設定される周波数は、各回線における信号の相互変調歪が互いに影響されない周波数に設定されることを特徴とする。

【０００８】ここで、各回線の周波数変換手段は、局部信号を発生するシンセサイザと、この局部発振信号を受信信号と混合して受信信号を周波数変換するミキサとで構成され、前記シンセサイザの発振周波数は、受信信号の周波数と、その回線に設定された周波数とに基づいて動作される制御回路により可変制御されるように構成する。

【０００９】なお、無線信号を受信する受信機と、受信した信号を増幅する低雑音増幅器とを備え、この増幅された受信信号をｎ回線に分離するように構成することが好ましい。また、各回線には、各回線に設定された周波数に対応して１回線の帯域を制限する帯域通過ろ波器を有することが好ましい。

【００１０】

【作用】受信した信号はｎ回線に分離され、各回線路においてそれぞれ周波数変換され、かつレベルが等しくされた上で合成され、光変調されて光信号として送出される。各回線路における周波数を、予め相互変調歪が生じない周波数配置となるように設定しておくことにより、受信信号のレベル差が大きい場合でも相互変調歪の影響を受けず、かつＳ／Ｎの劣化が生じない光変調が実現できる。

【００１１】

【実施例】次に、本発明の実施例を図面を参照して説明する。図１は本発明の一実施例のブロック構成図であり、ここでは図３に示した移動体通信の光マイクロセル通信方式の基地局に適用した例を示している。受信機１はｎチャネルの回線（ｎは２以上の整数）を利用して多数の子局からの信号（多周波信号）を受信し、低雑音増幅器２はこの受信信号を増幅する。分離器３は多周波信号をｎ回線の周波数信号に分離する。これらｎ回線の回線路にはそれぞれミキサ４（４－１，４－２，４－３，…，４－ｎ）が設けられており、かつ各ミキサ４にはそれぞれ局部信号を発生するシンセサイザ５（５－１，５－２，５－３，…，５－ｎ）が接続され、各ミキサ４はこの局部信号を用いて受信信号をそれぞれ個別に周波数変換する。

【００１２】また、各ミキサ５にはそれぞれ異なる周波数帯域に設定された帯域通過ろ波器６（６－１，６－２，６－３，…，６－ｎ）が接続されており、周波数変換された信号の帯域制限を行なう。更に、各帯域通過ろ波器６には自動利得制御増幅器（ＡＧＣ増幅器）７（７－１，７－２，７－３，…，７－ｎ）が接続されて所定のレベルへの増幅を行う。また、合成器８は各増幅器の出力を合成し、電気光変換器９に出力する。この電気光変換器９は合成された信号を光変調し、得られた光信号を光ケーブル４００を通して制御局に送出する。

【００１３】ここで、前記した分離器３により分岐されたｎ回線の各回線路では、予め周波数配置がそれぞれに割り当てられており、各帯域通過ろ波器６はその割り当てられた周波数帯域の信号のみを透過するように設定されている。また、前記各シンセサイザ５は、自己の回線において受信した受信信号を、自己に割り当てられた周波数配置の周波数信号となるような周波数変換を行うために必要とされる周波数の局部信号を発生するように制御回路１０において制御が行われる。この場合、この実施例では前記分離器３で各回線に分配された周波数の情報が制御回路１０に入力され、この周波数の情報に基づいてシンセサイザ５の発振周波数の制御が行われるように構成される。

【００１４】この構成の受信回路によれば、受信機１で受信した最大でｎ回線の無線信号は低雑音増幅器２で増幅され、分離器３によって各回線の信号として分離される。そして、各回線の信号はそれぞれのミキサ４において各シンセサイザ５の出力と混合されて自己の回線に割り当てられている周波数帯域の信号として周波数変換され、その上で帯域通過ろ波器６により自己の回線の周波数帯域以外の信号を制限する。このとき、図２にＦ１～Ｆ４の４波の例で示すように、各回線における周波数配置は、それぞれの回線の信号がそれぞれの相互変調歪に影響しないように設定される。

【００１５】この図２の例では、Ｆ１とＦ２、Ｆ３とＦ４をΔFの周波数間隔とし、Ｆ２とＦ３を$\Delta 2F$の周波数間隔となるように設定することで、Ｆ１～Ｆ４の各信号の相互変調歪が相互に影響することがない配置となっている。なお、この周波数配置は信号数や歪成分の分布等によって、予めコンピュータ等を用いて設定しており、この設定に際しての技術は既に確立されているものであるからここでは詳細な説明は省略する。

【００１６】このように設定された周波数配置に対応して、制御回路１０では各回線にそれぞれ分配された受信信号の周波数を分離器３からの情報により認識し、この情報に基づいてシンセサイザ５の発振周波数を制御し、受信した信号が各回線に割り当てられた周波数配置の周波数信号となるような周波数の局部信号を各回線の混合器４に供給する。これにより、各回線の混合器４では、受信信号を自己の回線に割り当てられた周波数配置の周波数となるように周波数変換を行う。その上で、各回線の信号はＡＧＣ増幅器７により増幅されて各回線の信号が同一レベルとされ、かつ、増幅された信号は合成器８において合成され、電気光変換器９によって光変調され、光信号として光ケーブル４００により伝送される。

【００１７】したがって、各回線における周波数信号は、互いに相互変調歪が生じることがない周波数関係となって合成器８において合成される。また、この合成に

際してはそれぞれのＡＧＣ増幅器によって各回線の受信信号レベルが等しい状態で合成される。これにより、受信信号のレベル差が大きい場合でも、合成される時点では相互変調歪の影響やＳ／Ｎの劣化が生じることがなく、光ファイバによる長距離の光信号の伝送が可能となる。また、特殊な素子を必要とすることもない。

【００１８】

【発明の効果】以上説明したように本発明は、受信した信号をｎ回線に分離し、各回線路においてそれぞれ周波数変換し、かつレベルが等しくなるように増幅した上で各回線の信号を合成し、これを光変調されて光信号を得ており、その際に各回線路における周波数を、予め相互変調歪が生じない周波数配置となるように設定しているので、受信信号のレベル差が大きい場合でも相互変調歪の影響を受けず、かつＳ／Ｎの劣化が生じない光変調が実現できる。したがって、特殊な構成素子を用いる必要がなく、しかも光ファイバによる長距離の伝送が実現できる。

【００１９】各回線における周波数変換手段では、局部信号を発生するシンセサイザの発振周波数を、受信信号の周波数と、その回線に設定された周波数とに基づいて可変制御されるように構成することにより、受信信号の周波数の違いにかかわらず、受信信号を各回線において処理することが可能となる。

【００２０】なお、受信した信号を増幅する低雑音増幅＊＊器を備えることで、受信回路の感度を高めることができる。また、各回線には、各回線に設定された周波数に対応して１回線の帯域を制限する帯域通過ろ波器を設けることで、各回線の信号を合成する際の周波数の重なりを回避し、その際の歪の発生やＳ／Ｎの劣化を防止する。

【図面の簡単な説明】

【図１】本発明の受信回路の一実施例のブロック構成図である。

【図２】本発明にかかる受信信号の周波数変換の一例を示す周波数配置図である。

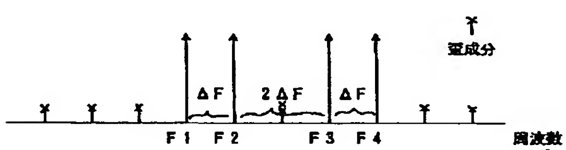
【図３】本発明が適用される光マイクロセル通信方式の一部の構成図である。

【図４】従来の受信回路の一例を示すブロック構成図である。

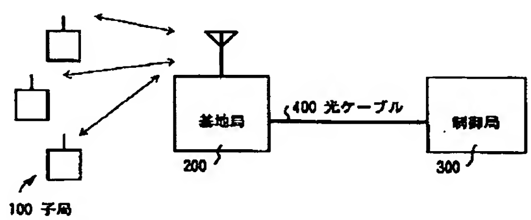
【符号の説明】

１　受信機
２　低雑音増幅器
３　分離器
４　ミキサ
５　シンセサイザ
６　帯域通過ろ波器
７　ＡＧＣ増幅器
８　合成器
９　電気光変換器
１０　制御回路

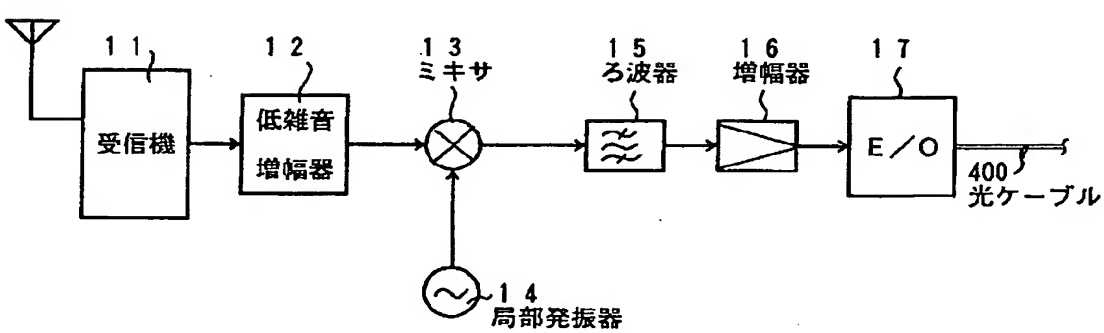
【図２】



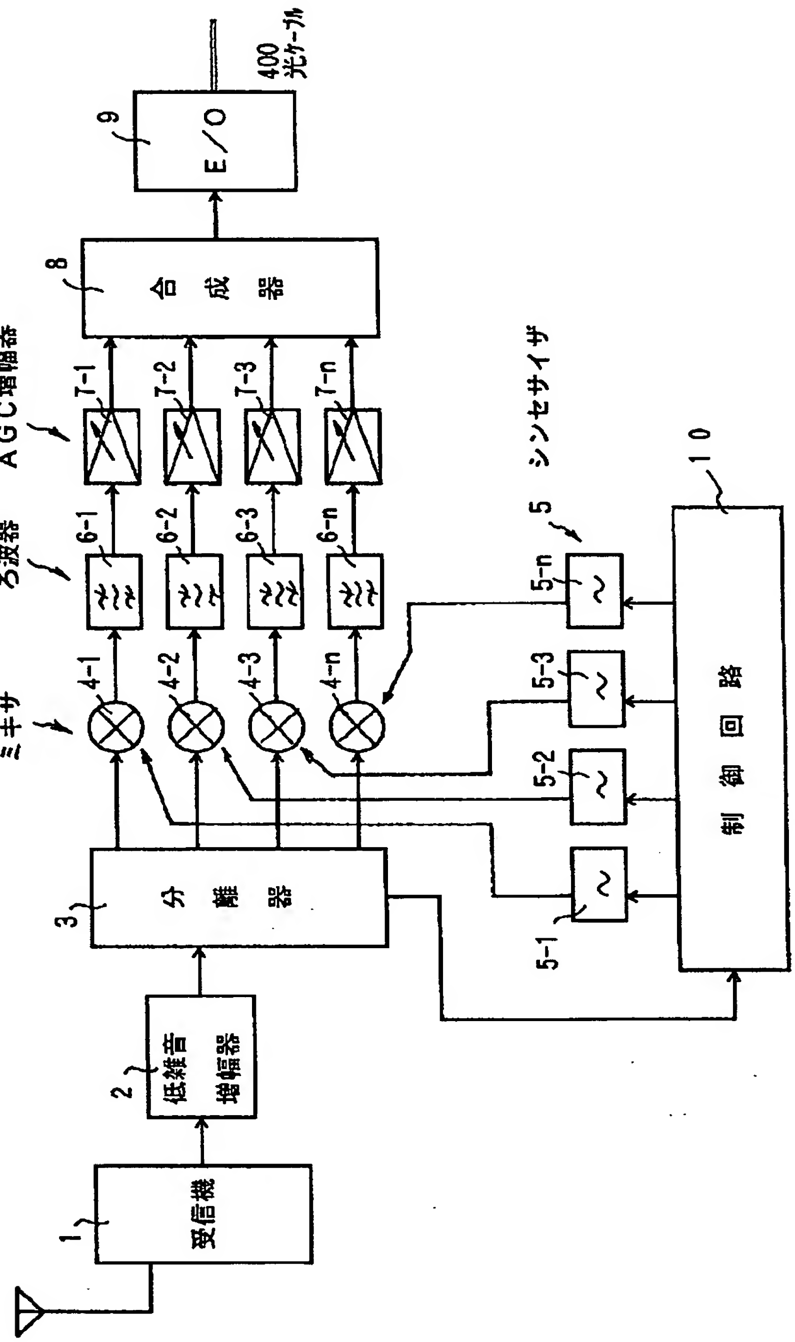
【図３】



【図４】



【図1】


400 光ケーブル
9 E／O
8 合成器
7 AGC増幅器
7-1
7-2
7-3
7-n
6 ろ波器
6-1
6-2
6-3
6-n
4 ミキサ
4-1
4-2
4-3
4-n
5 シンセサイザ
5-1
5-2
5-3
5-n
10 制御回路
3 分離器
2 低雑音増幅器
1 受信機